US006488125B1

(12) **United States Patent**
Otsuka et al.

(10) **Patent No.: US 6,488,125 B1**
(45) **Date of Patent: Dec. 3, 2002**

(54) TRACTION ELEVATOR

(75) Inventors: **Motoharu Otsuka**; **Hidehiko Kobayashi**, both of Kanagawa-ken (JP)

(73) Assignee: **Kabushiki Kaisha Toshiba**, Kawasaki (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/248,313**

(22) Filed: **Feb. 11, 1999**

(30) **Foreign Application Priority Data**

Mar. 12, 1998 (JP) 10-061194

(51) **Int. Cl.**[7] **B66B 11/08**
(52) **U.S. Cl.** **187/264**; 187/254; 187/266; 187/414
(58) **Field of Search** 187/294, 251, 187/256, 264, 266, 405, 414

(56) **References Cited**

U.S. PATENT DOCUMENTS

2,537,075	A	*	1/1951	Margles	
3,810,529	A	*	5/1974	Tosato et al.	187/404
3,882,968	A	*	5/1975	Suozzo	187/404
5,103,937	A	*	4/1992	Robertson	187/254

FOREIGN PATENT DOCUMENTS

JP	351112048	*	10/1976	
JP	1-118967		8/1989	
JP	404217579	*	8/1992	
JP	5-178564	*	7/1993	187/414
JP	406064863	*	3/1994	
JP	406211463	*	8/1994	
JP	9-315728		12/1997	

OTHER PUBLICATIONS

Derwent English Abstract for Japanese Patent JP2000034073A, Feb. 2000.*

English Abstract, Japanese Patent JP353043346A, Apr. 1978.*

US Statutory Invention Registration, H702, whole document, Nov. 1989.*

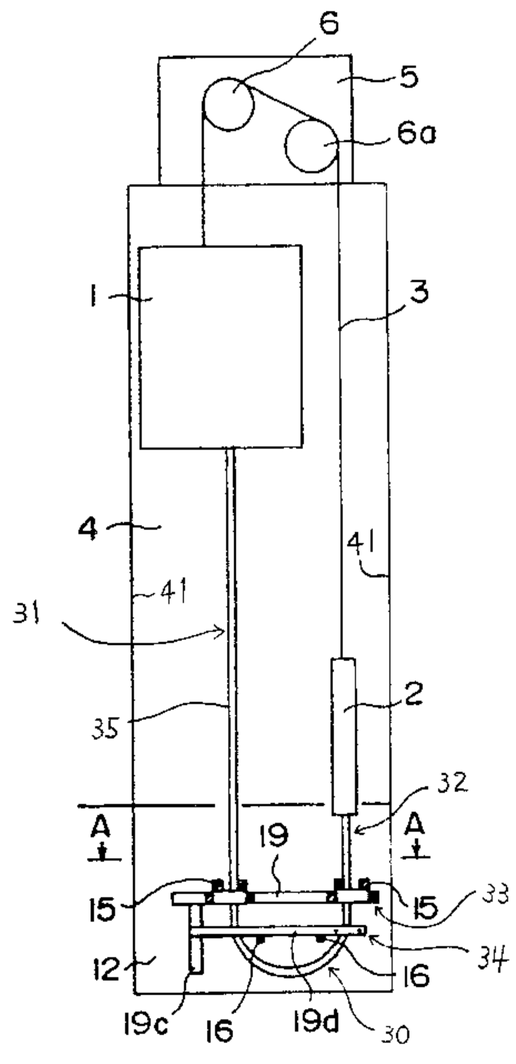
* cited by examiner

Primary Examiner—Robert P. Olszewski
Assistant Examiner—Steven B. McAllister
(74) *Attorney, Agent, or Firm*—Oblon, Spivak, McClelland, Maier & Neustadt, P.C.

(57) ABSTRACT

An elevator has a rope connected at a first end thereof to a top of a car and at a second end thereof to a top of a counterweight and guided and driven by a sheave that is rotated by a motor. A compensating rope suspends between the car and the counterweight. The compensating rope has a curving portion, a first linear portion on the car side of the curving portion, and a second linear portion on the counterweight side of the curving portion for compensating an imbalance of weight between a portion of the rope on the car side of the sheave and a portion of the rope on the counterweight side of the sheave. A first guide is arranged to guide the first linear portion and the second linear portion, and a second guide is arranged below the first guide and positioned between lines extending from the first linear portion and the second linear portion for guiding the curving portion of the compensating rope. A frame is arranged in a pit of an elevator shaft for supporting the first guide and the second guide.

11 Claims, 9 Drawing Sheets



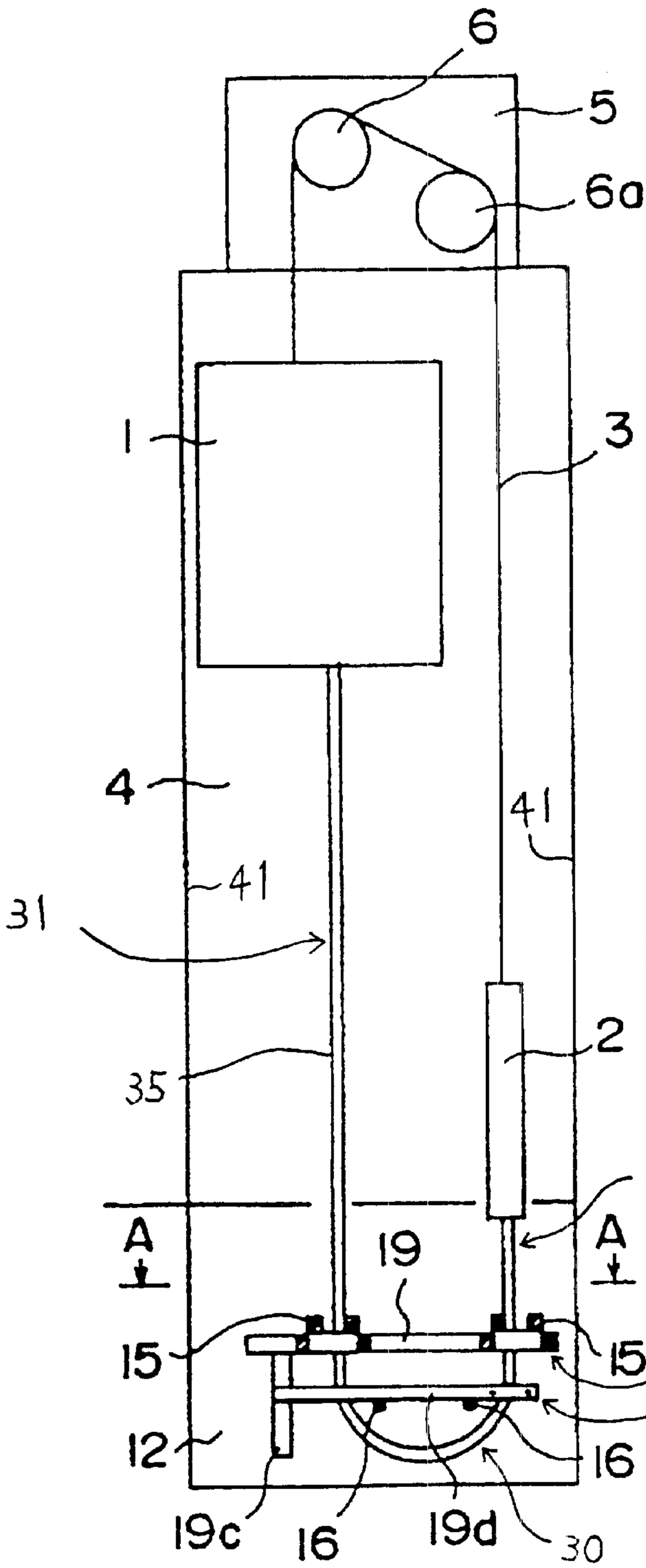

6
5
6a
1
3
4
41
41
31
2
35
32
A
A
19
15
15
33
34
12
16
19c
16
19d
30

FIG. 1(a)

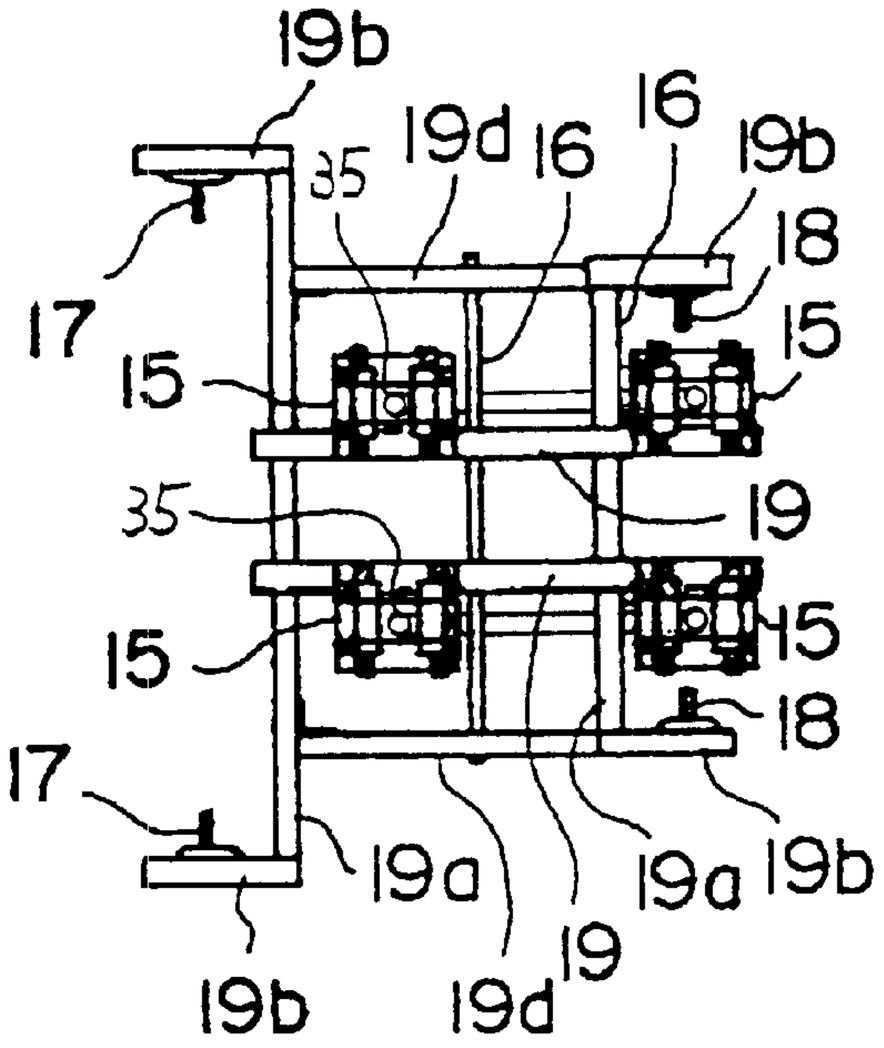

19b
19d
16
16
19b
35
18
17
15
15
35
19
15
18
17
19a
19a
19b
19b
19d
19

FIG. 1(b)

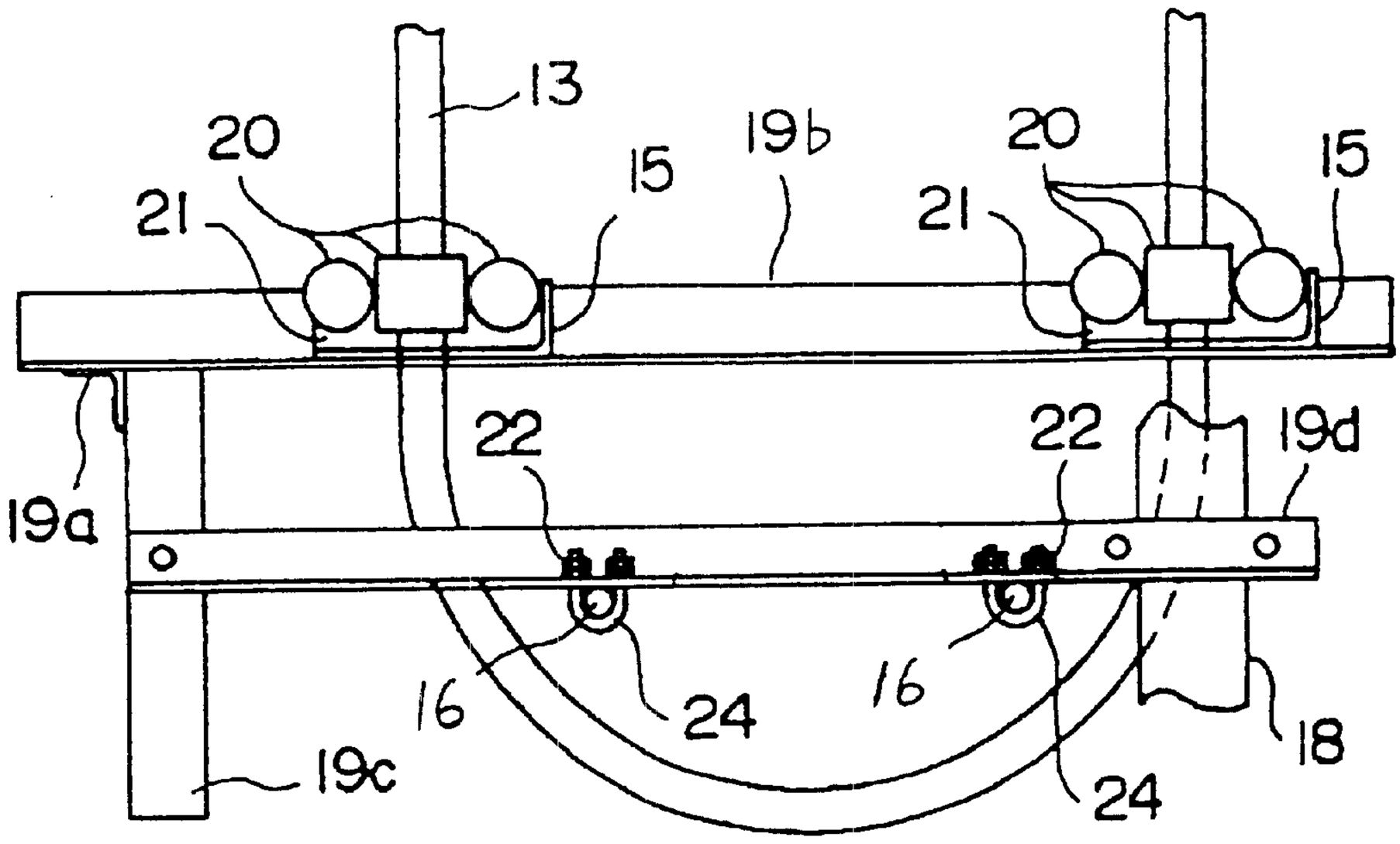

13
20
21
15
19b
20
21
15
22
22
19d
19a
16
24
16
18
19c
24

FIG. 2

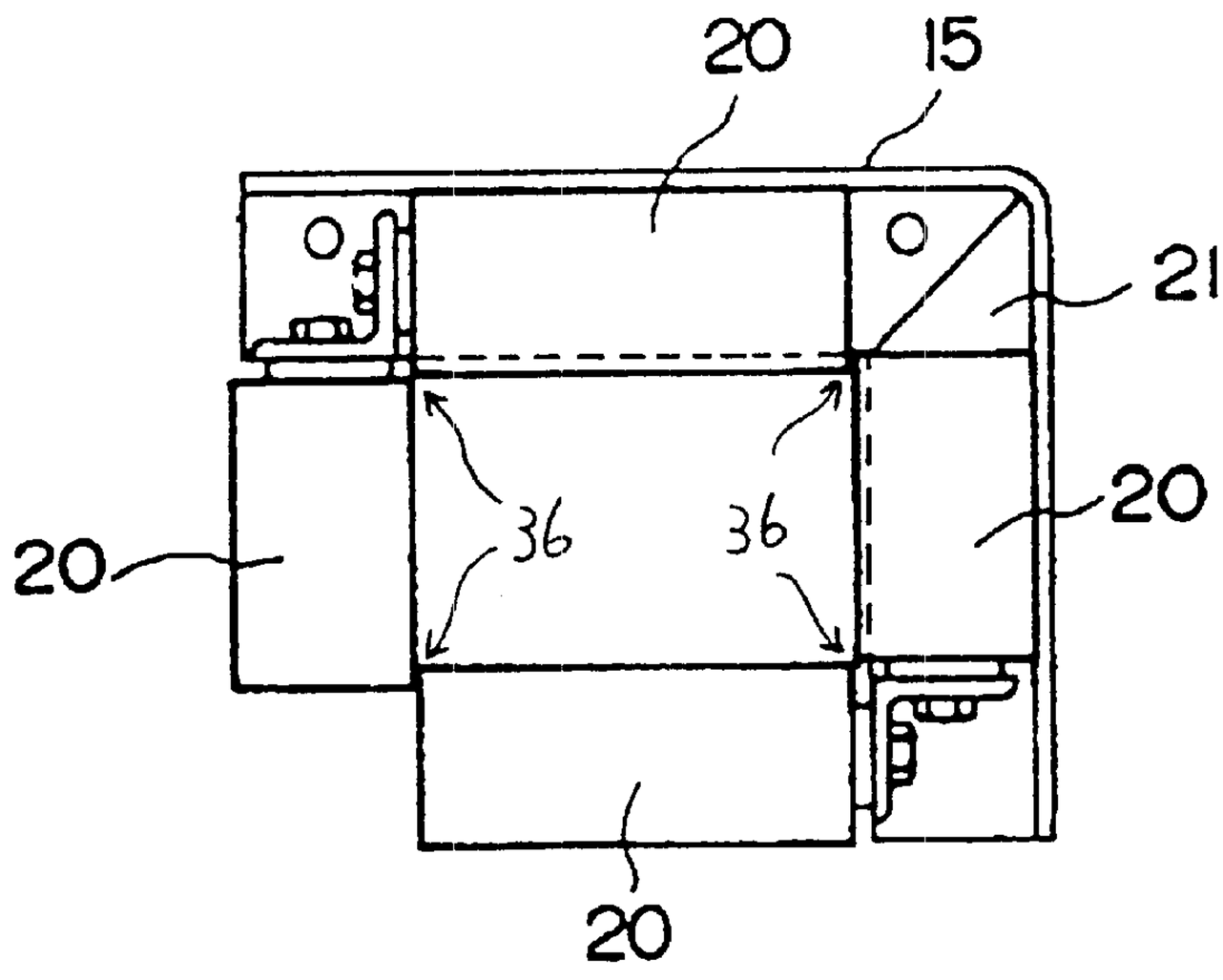

20
15
21
20
36
36
20
20

FIG. 3

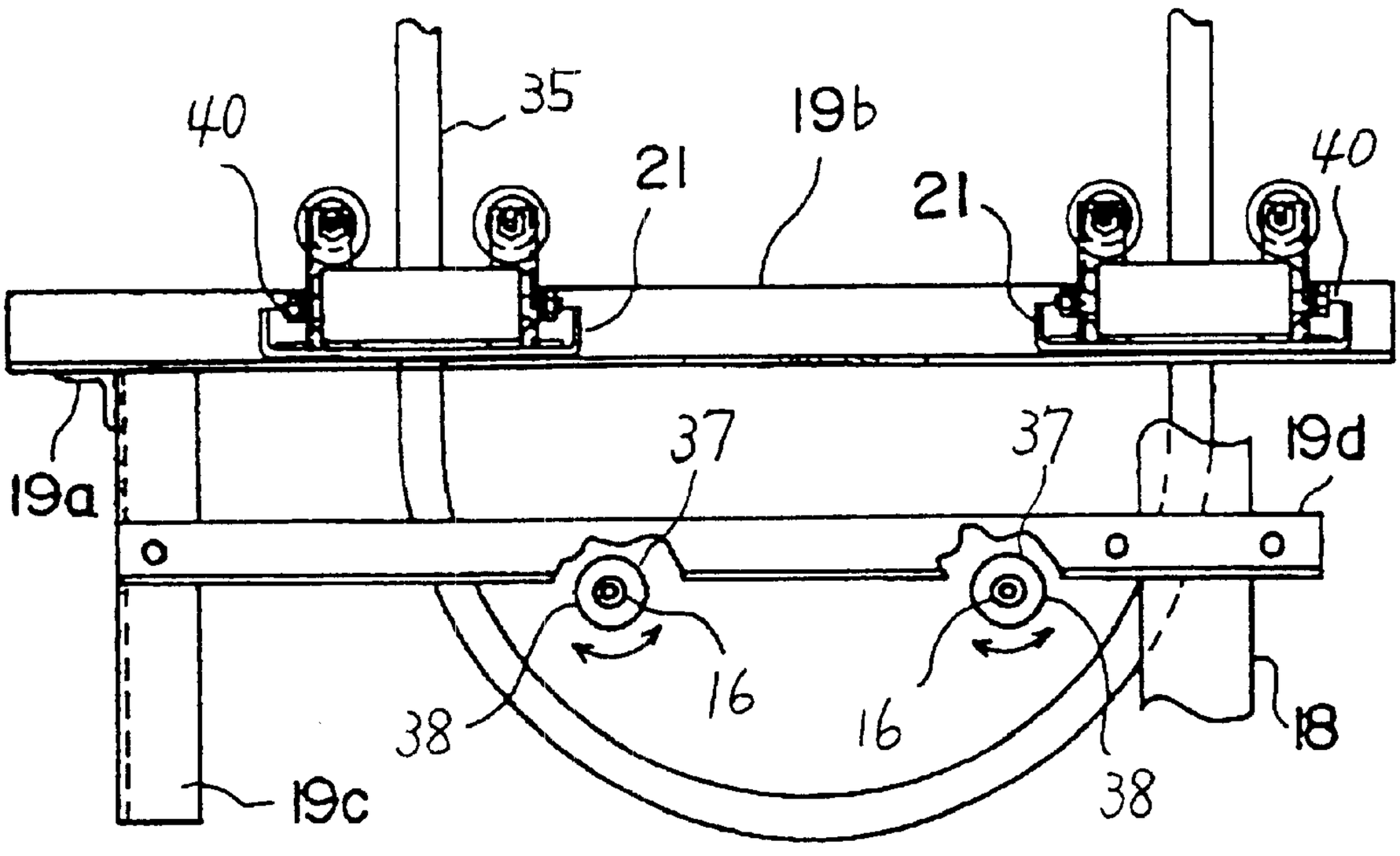

40
35
19b
21
21
40
19a
37
37
19d
16
16
38
38
18
19c

FIG. 4

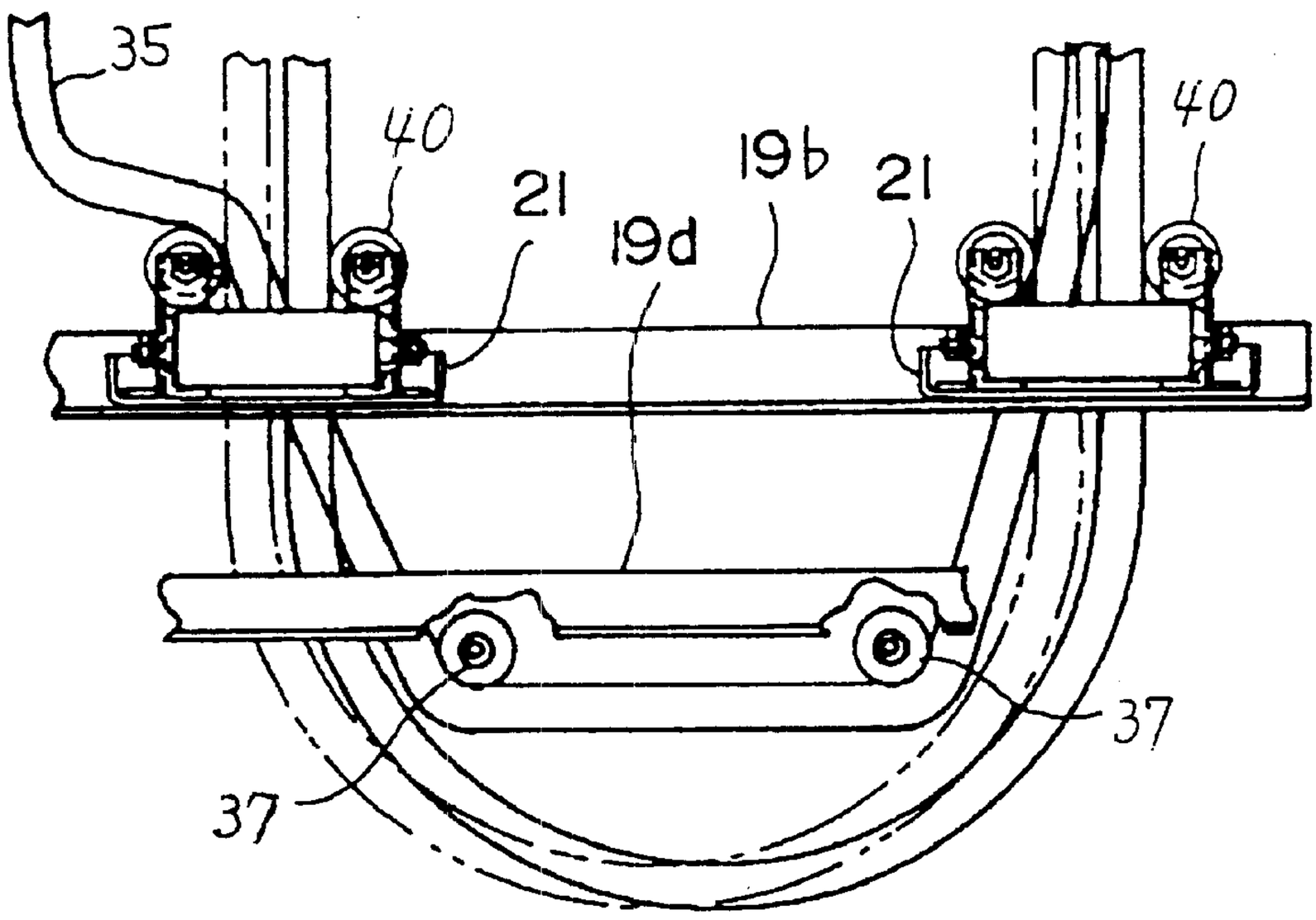

35
40
21
19d
19b
21
40
37
37

FIG. 5

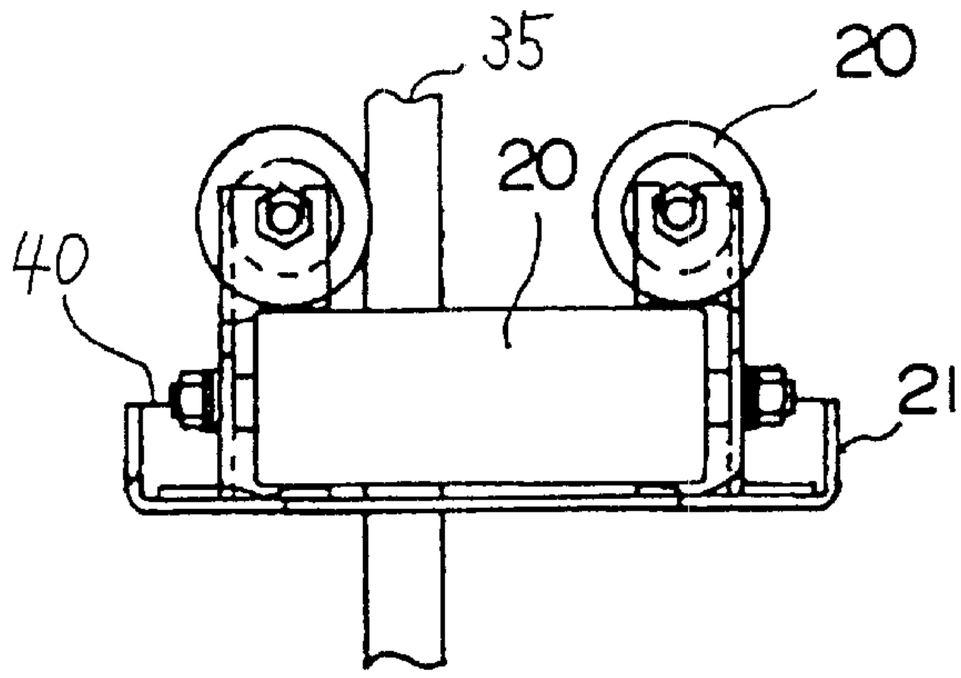


FIG. 6

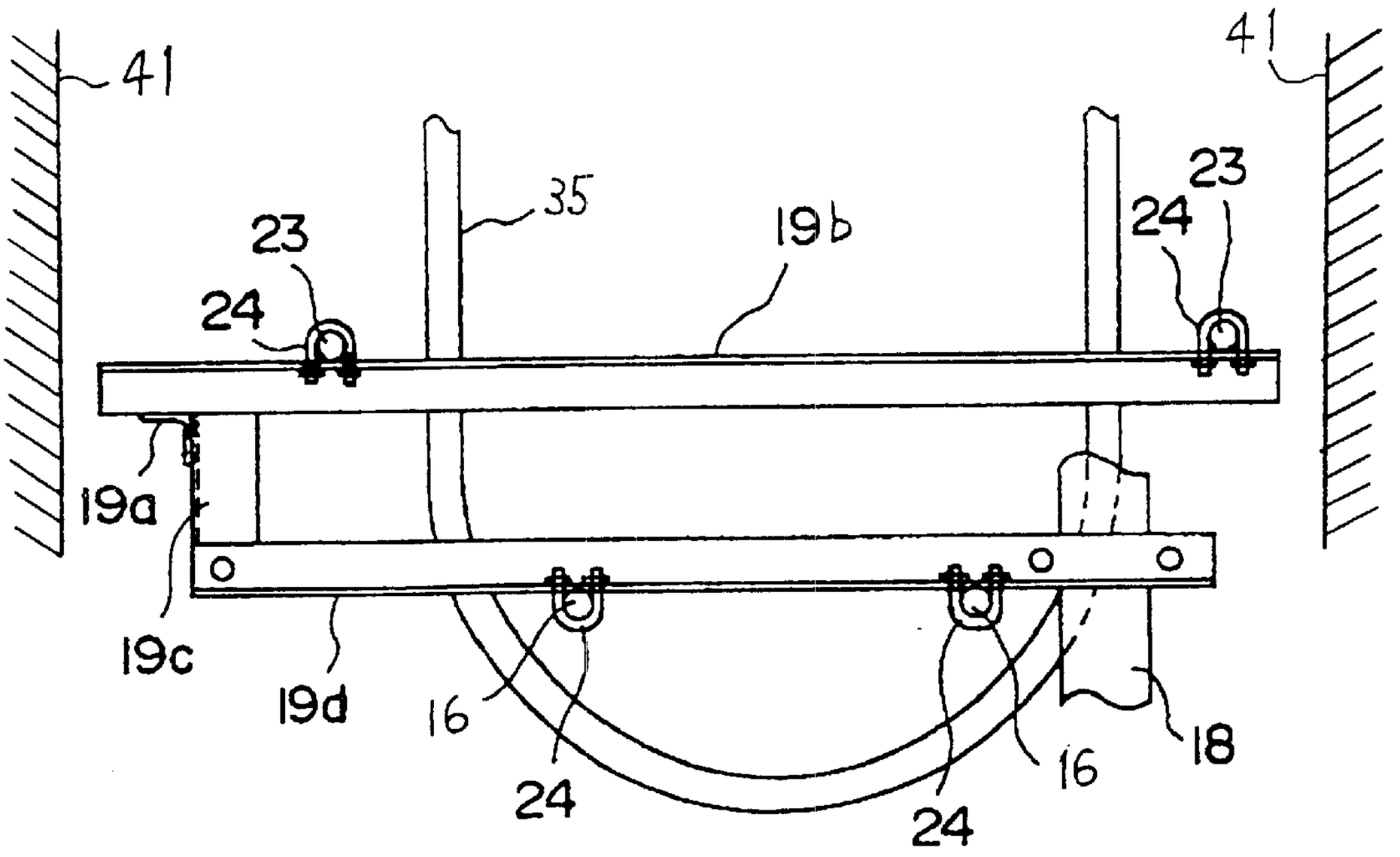


FIG. 7

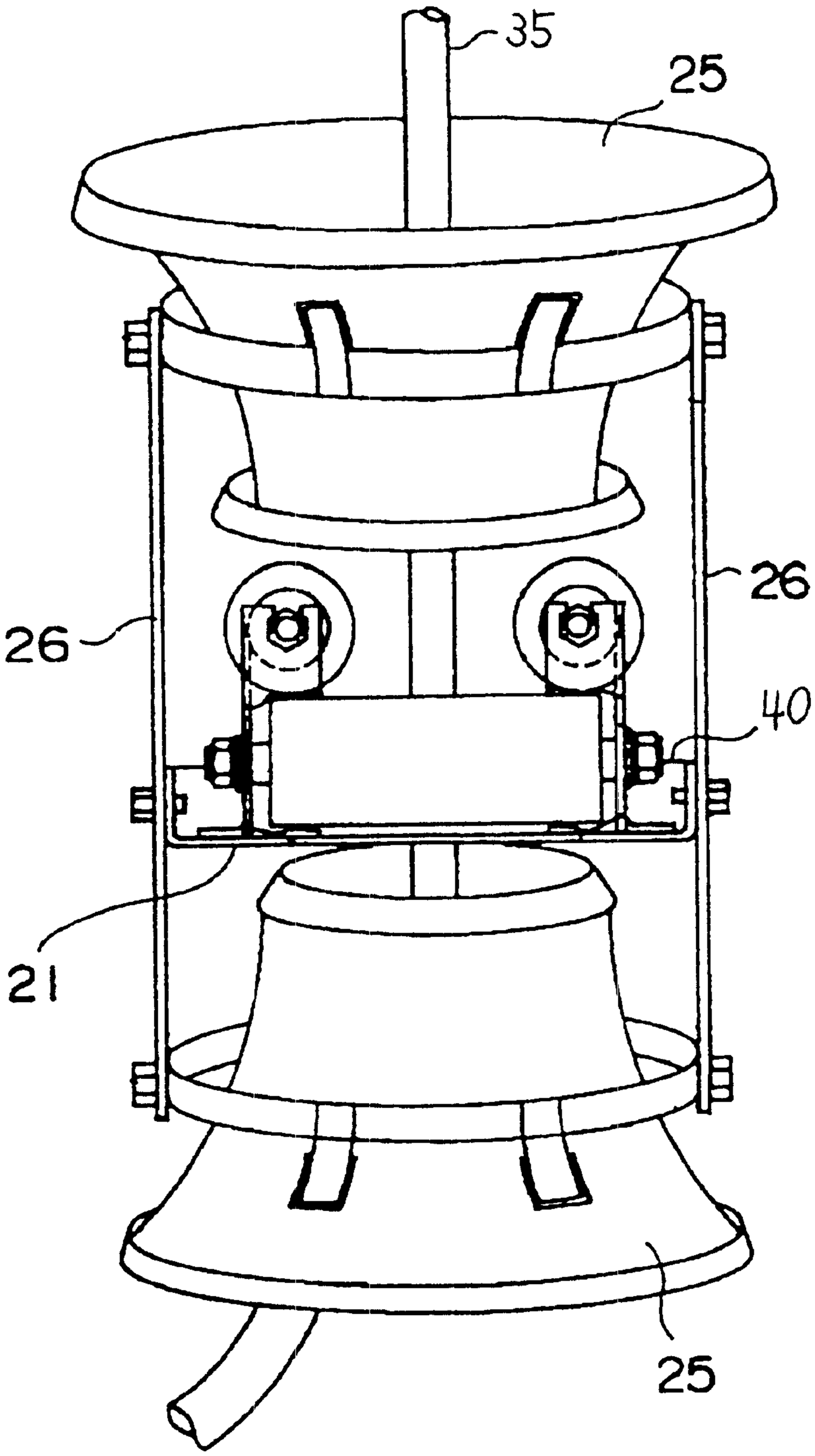


FIG. 8

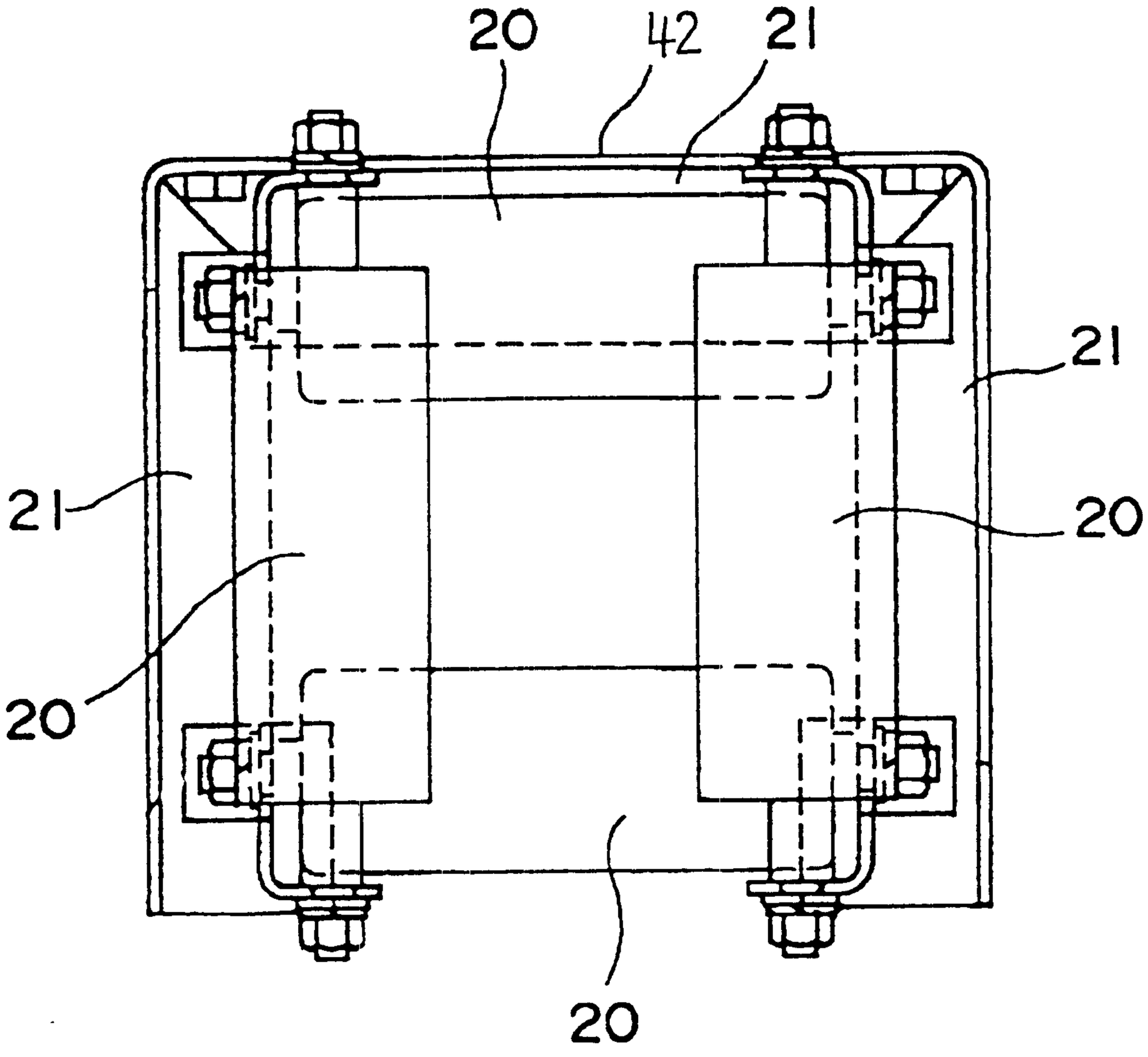


FIG. 9

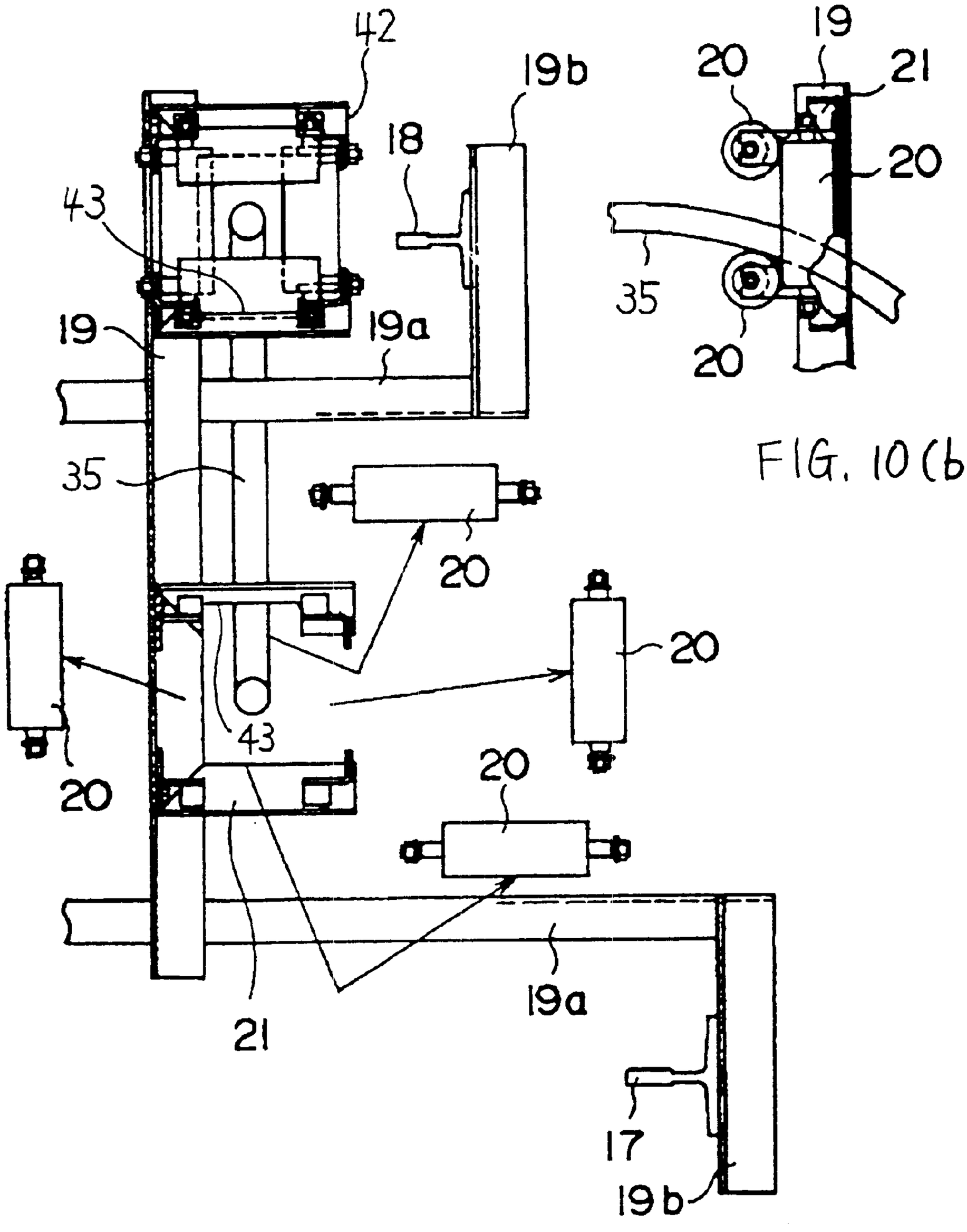


FIG. 10(a)

FIG. 10(b)

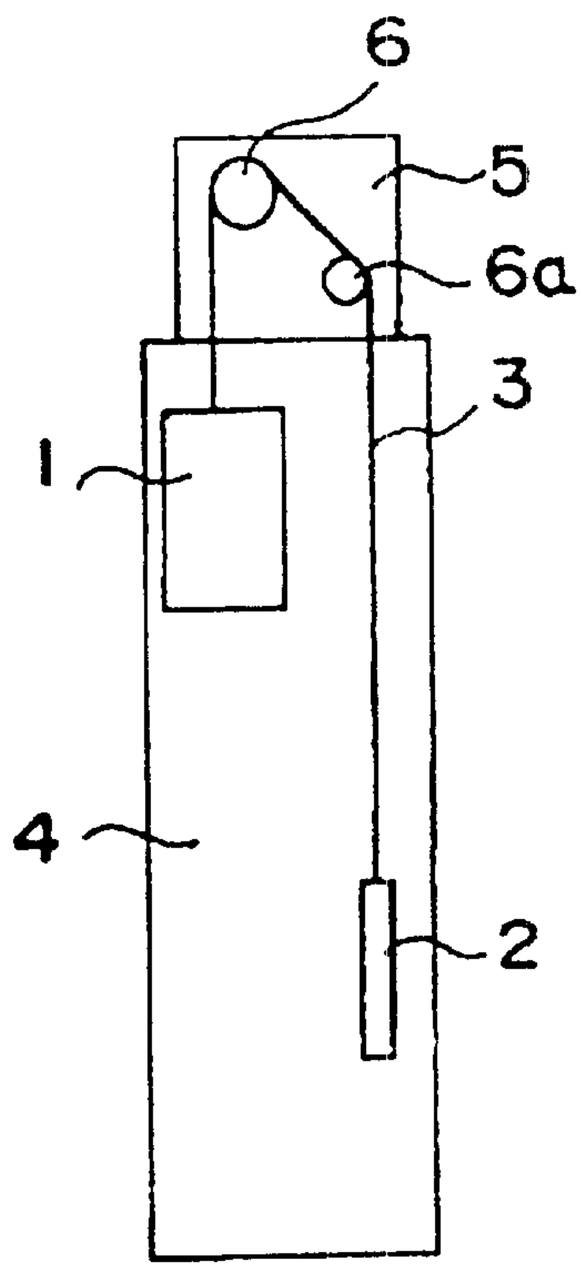


FIG. 11(a)
(PRIOR ART)

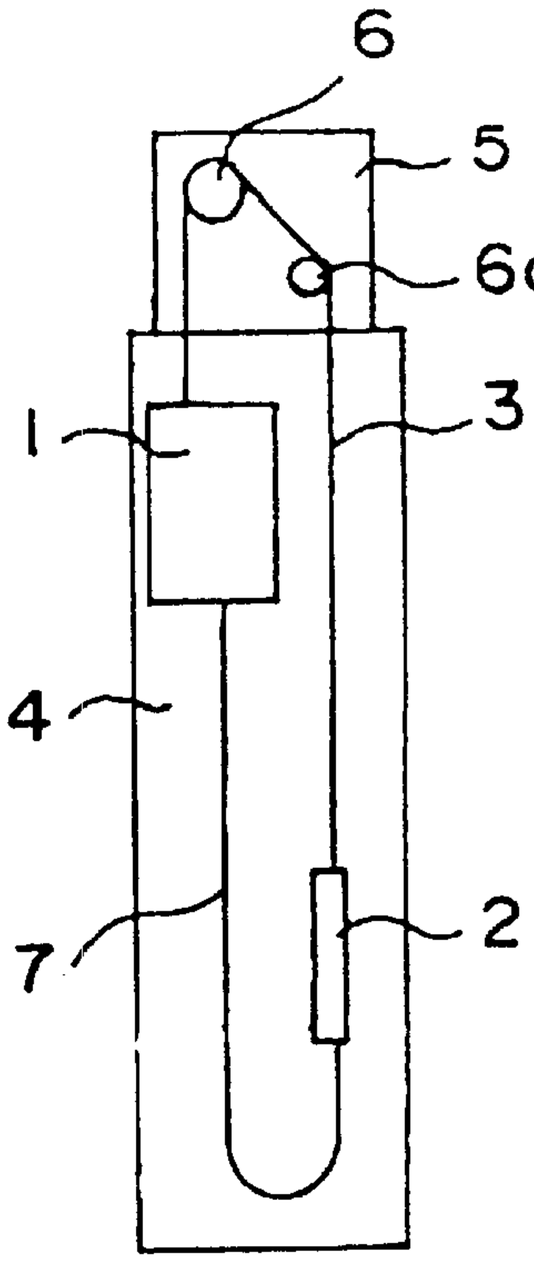


FIG. 11(b)
(PRIOR ART)

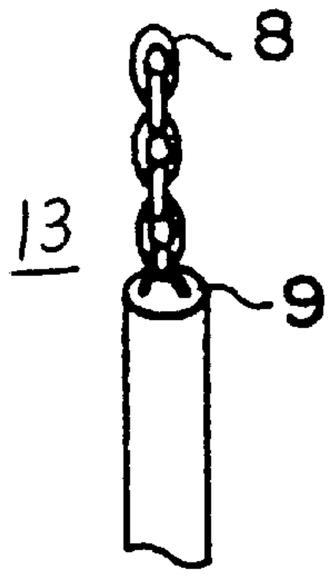


FIG. 12(a)
(PRIOR ART)

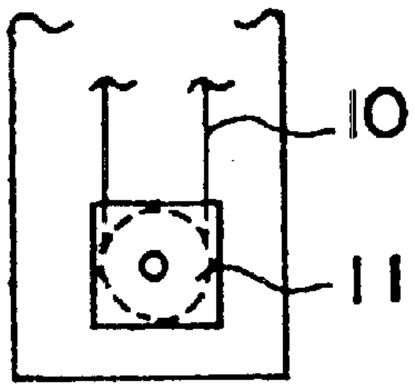


FIG. 12(b)
(PRIOR ART)

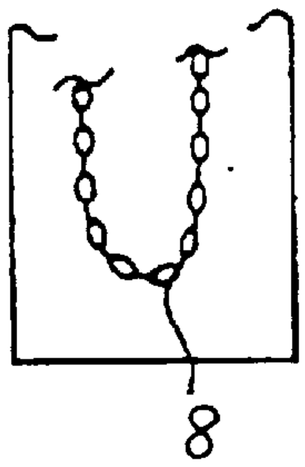


FIG. 12(c)
(PRIOR ART)

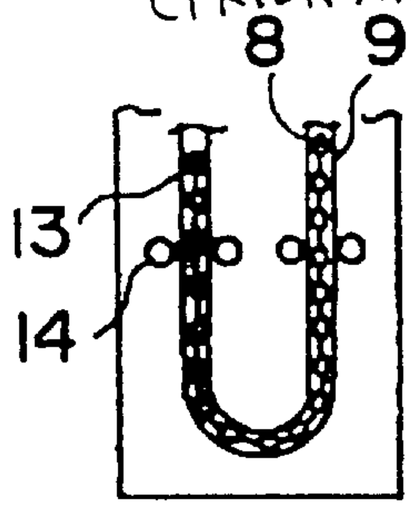


FIG. 12(d)
(PRIOR ART)

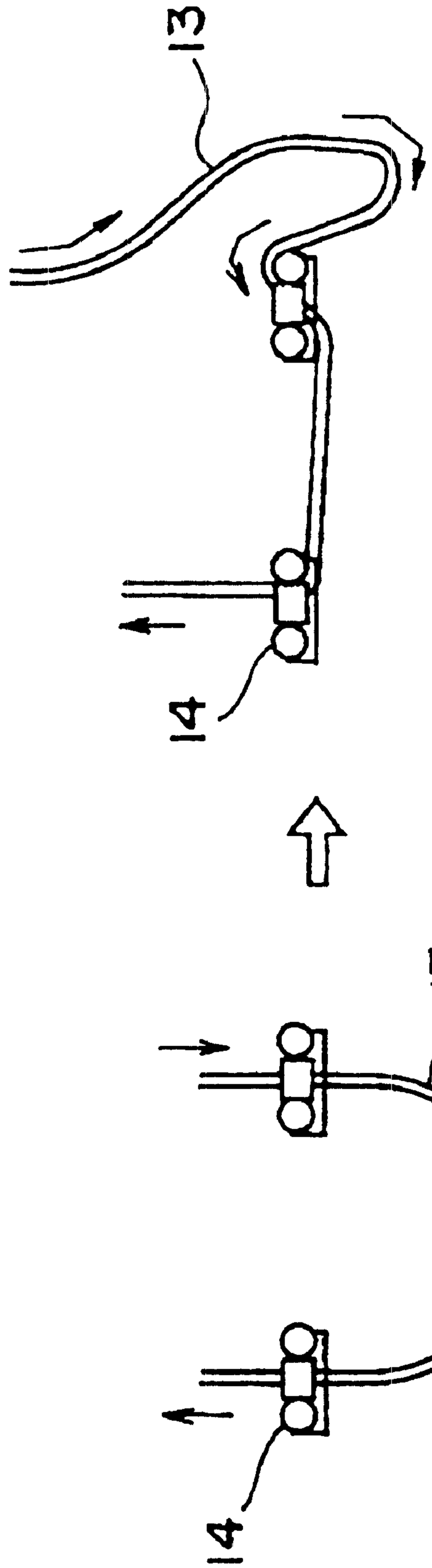


FIG. 3 (PRIOR ART)

TRACTION ELEVATOR

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a traction elevator having a compensating rope guide, and more particularly to a traction elevator that can reduce the swing of the compensating rope so as to stop the emission of unpleasant noise and vibration of an elevator car, and thus increase the comfort of the ride in the car.

2. Discription of the Related Art

FIG. **11**(*a*) is a side view of an ordinary type of widely used traction elevator. In the traction elevator, three ropes **3** (only one is shown) are attached at a first end thereof to a top of a the car **1**, and at a second end thereof to a top of a counterweight **2**. The ropes **3** are guided by a deflector sheave **6***a* and a sheave **6** driven by a motor in a machine room **5** located over an elevator shaft **4**. Friction between the ropes **3** and sheave **6** raises and lowers the car **1** in order to carry passengers and freight.

However, in a traction elevator operating in a very tall shaft, if there is an imbalance of weight between a portion of ropes **3** on the car **1** side of sheave **6** and a portion of the ropes **3** on the counterweight **2** side of sheave **6**, the ropes **3** might slip on the sheave **6**. Therefore, in the traction elevator operating in a tall shaft, as shown in FIG. **11**(*b*), a compensating rope **7** is usually attached at a first end thereof to the bottom of the car **1**, and at a second end thereof to the bottom of the counterweight **2**.

Then, this kind of the compensating rope **7** can be roughly classified into three types.

First, as shown in FIG. **12**(*b*), a wire rope **10** such as the rope **3** is used as the compensating rope **7**. Second, as shown in FIG. **12**(*c*), a chain **8** made of steel is in use as the compensating rope **7**. Third, as shown in FIG. **12**(*a*), a coated chain **13** composed of the chain **8** covered with coating **9** such as resin is also used as the compensating rope **7**.

In the following description, the wire rope **10**, the chain **8** and the coated chain **13** are referred to generically as the compensating rope **7**.

As shown in FIG. **12**(*b*), the wire rope **10** is generally used in a high-speed elevator, and a tension pulley **11** is usually attached at the curving portion of the wire rope **10** to tension the wire rope **10**. Accordingly, the tension pulley **11** lowers the vibration of the wire rope **10** and puts the wire rope **10** in orbit.

The chain **8** is usually used in a relatively low-speed elevator. As shown in FIG. **12**(*c*), this type of the chain **8** can omit the tension pulley **11** attached at the curving portion of the wire rope **10** in FIG. **12**(*b*), and thus reduce the cost of equipment, because the chain **8** does not swing as easily as the wire rope **10** when hanging with the tension of its own weight.

However, if the chain **8** is used in a high-speed elevator, the chain **8** makes noise and swings more than the wire rope **10** in a condition of hanging with the tension of the weight of the tension pulley **11** in FIG. **12**(*b*). Although the chain **8** does not swing as easily as the wire rope **10** when hanging with the tension of its own weight, the chain **8** is not available in the high-speed elevator.

In recent years, the coated chain **13** compromising the wire rope **10** and the chain **8** has been adopted.

As shown in FIG. **12**(*d*), the coated chain **13** includes the chain **8** covered with the coating **9** that reduces noise.

Further, guides composed of small rollers **14** are arranged above the curving portion of the coated chain **13** in order to reduce the swing of the coated chain **13**. Therefore, the coated chain **13** can be adopted for a high-speed elevator.

However, as shown in FIG. **13**, when a building with an elevator sways due to a sudden gust of wind or an earthquake, the coated chain **13** swings and the n se ems to shift over the rollers **14** at the downward side of the guides. On the other hand, at the upward side of the guides, the coated chain **13** is pulled by the car **1** or the counterweight **2** and goes up as it is. Accordingly, the coated chain **13** is strongly pressed against the rollers **14** and an angle bracket (not shown) supporting the rollers **14** at an acute angle, and then the coated chain **13** em its unpleasant noise due to resistance between the coated chain **13** and the rollers **14**. Further, since the coated chain **13** is caught in a corner of the rollers **14**, a rotation of the rollers **14** becomes difficult. As a result, the car **1** begins to vibrate, and the vibration may negatively influence the comfort of the ride in the car **1**.

SUMMARY OF THE INVENTION

Accordingly, one object of this invention is to provide a traction elevator having a compensating rope guide which can reduce the swing of a compensating rope so as to stop the emission of unpleasant noise and vibration of an elevator car, and thus avoid negatively influencing the comfort of the ride in the car.

The object of this invention can be achieved by providing an elevator having a rope connected at the first end thereof to the top of a car and at the. second end thereof to the top of a counterweight, and guided and driven by a sheave which is rotated by a motor, composed of a compensating rope suspended from the car to the counterweight, the compensating rope having a curving portion, a first linear portion on the car side of the curving portion and a second linear portion on the counterweight side of the curving portion for compensating an imbalance of weight between a portion of the rope on the car side of the sheave and a portion of the rope on the counterweight side of the sheave. A first guide is arranged to guide the first linear portion and the second linear portion. A second guide is arranged below the first guide and positioned between the extended lines of the first linear portion of the compensating rope and the second linear portion of the compensating rope for guiding. the curving portion of the compensating rope. A frame is arranged in the pit of an elevator shaft for supporting the first guide and the second guide.

BRIEF DESCRIPTION OF THE DRAWINGS

A more complete appreciation of the invention and many of the attendant advantages thereof will be readily obtained as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings, wherein:

FIG. **1**(*a*) is a side view showing a shaft of a traction elevator having a compensating rope guide of a first embodiment of the present invention;

FIG. **1**(*b*) is atop view taken along line A—A in FIG. **1**(*a*);

FIG. **2** is a side view of first guide and second guide of the first embodiment;

FIG. **3** is a plan view of rotatable member of the first embodiment;

FIG. **4** is a side view of a compensating rope guide of a second embodiment of the present invention;

FIG. **5** is an illustrative diagram showing an example of the operation of compensating rope in FIG. **4**;

FIG. **6** is a side view of a rotatable member of compensating rope guide of a second embodiment of the present invention;

FIG. **7** is a side view of a compensating rope guide of a third embodiment of the present invention;

FIG. **8** is a side view of a compensating rope guide of a fourth embodiment of the present invention;

FIG. **9** is a side view of a rotatable member of compensating rope guide of a fifth embodiment of the present invention;

FIG. **10**(*a*) is a plan view of a rotatable member of a compensating rope guide of a sixth embodiment of the present invention;

FIG. **10**(*b*) is a cross-sectional view of the rotatable m ember in FIG. **10**(*a*);

FIGS. **11**(*a*) and **11**(*b*) are side views of ordinary types of traction elevators which have been widely used;

FIGS. **12**(*a*) **12**(*b*), **12**(*c*) and **12**(*d*) show various compensating rope designs; and

FIG. **13** is an illustrative diagram showing an example of the operation of compensating rope.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawings, wherein like reference numerals designate identical or corresponding parts throughout the several views, the embodiments of the present invention are described below.

FIG. **1**(*a*) is a side view showing the construction of a shaft of a traction elevator having a compensating rope guide of a first embodiment of the present invention. FIG. **1**(*b*) is a view in the direction of an arrow A—A in FIG. **1**(*a*).

As shown in FIGS. **1**(*a*) and **1**(*b*), in this embodiment, three ropes **3** (only one is shown) are attached at a first end thereof to a top of a the car **1** and at a second end thereof to a top of a counterweight **2**. The ropes **3** are guided by a deflector sheave **6***a* and a sheave **6** driven by a motor in a machine room **5** located over an elevator shaft **4**. Two compensating ropes **35** are suspended from the car **1** to the counterweight **2**. Each of the compensating ropes **35** has a curving portion **30**, a first linear portion **31** on the car **1** side of the curving portion **30** and a second linear portion **32** on the counterweight **2** side of the curving portion **30** for compensating an imbalance of weight between the portion of the ropes **3** on the car **1** side of the sheave **6** and the portion of the ropes **3** on the counterweight side of the sheave **6**. A first guide **33** is arranged in a pit **12** located below the lowest floor for guiding the first linear portions **31** and the second linear portions **32** in the pit **12**. A second guide **34** is arranged below the first guide **33** and positioned between the extended lines of the first linear portions **31** of the compensating ropes **35** and the second linear portions **32** of the compensating ropes **35** for guiding the curving portions **30** of the compensating ropes **35**. The compensating ropes **35** such as the coated chain **13** in FIG. **12**(*d*) are guided by the first guide **33** and the second guide **34**.

The first guide **33** and the second guide **34** are supported by a frame **19** fixed to a pair of car guide rails **17** for guiding the car **1** and a pair of counterweight guide rails **18** for guiding the counterweight **2**. The frame **19** is composed of brackets **19***a*, **19***b*, **19***c* and **19***d*. Further, the first guide **33** is composed of four rotatable members **15** so that the compensating ropes **35** are directed in the moving directions of the compensating ropes **35**. Furthermore, the second guide **34** is composed of two bars **16**.

FIG. **2** is a side view of the first guide **33** and the second guide **34** of the first embodiment shown in FIG. **1**. FIG. **3** is a plan view of one of the rotatable members **15** of the first embodiment.

As shown in FIG. **2** and FIG. **3**, each of the rotatable members **15** is composed of four cylindrical rollers **20** supported by an angle bracket **21** and fixed to the bracket **19***b*. The bars **16** are fixed to the bracket **19***d* with U-shaped bolts **24** and nuts **22**.

Each surface of cylindrical rollers **20** is composed of a low friction member having low frictional property against a surface of the compensating ropes **35**. Urethane rubber, Bakelite, Aluminum alloy and Nylon are appropriate for the low friction member, and Polyethylene is also available.

According to this traction elevator, the first guide **33** guides the first linear portions **31** and the second linear portions **32** of the compensating ropes **35** and the second guide **34** guides the curving portions **30** of the compensating ropes **35**. Accordingly, even if the compensating ropes **35** swing and seem to shift over the first guide **33**, the second guide **34** prevents the compensating ropes **35** from moving over the first guide **33**. As a result, there is no possibility of the compensating ropes **35** swaying seriously, and the comfort of the ride in the car **1** is not influenced. Further, this traction elevator stops the emission of unpleasant noise and vibration of the car **1** and provides a pleasant environment for residents and passengers.

Furthermore, since the surfaces of the cylindrical rollers **20** are composed of low friction member having low frictional properties against the surfaces of the compensating ropes **35**, the compensating ropes **35** are not caught in any of the corners **36** of the cylindrical rollers **20**.

FIG. **4** is a side view of the compensating rope guide of a second embodiment of the present invention. In the following description, only components different from components explained in the first embodiment are described. In this embodiment, the first guide **33** and the second guide **34** in the first embodiment are modified. The rotatable member **15** in FIG. **2** is substituted by a rotatable member **40**. The first guide is composed of four rotatable members **40** shown in FIG. **6**. Each of rotatable member **40** is composed of four cylindrical rollers **20** supported by the angle bracket **21** like the rotatable member **15** in FIG. **3**. Each cylindrical roller **20** forms one side of a quadrilateral, and the two facing pairs of the cylindrical rollers **20** mutually intersect. One facing pair of the cylindrical rollers **20** is located above the other. The second guide **34** is composed of two second rotatable members **37** fixed to the bracket **19***d* so that the compensating ropes **35** are directed in the direction in which they are moving. Each of the second rotatable members **37** consists of the bar **16** and a cylindrical cover **38** rotatably covering a surface of the bar **16**.

The second rotatable members **37** are arranged to contact and guide the compensating ropes **35** when the compensating ropes **35** swing by a predetermined distance from their stationary position.

According to this embodiment, since the two pair of cylindrical rollers **20** which mutually intersect are placed one above the other, if the compensating ropes **35** hit a corner of the cylindrical rollers **20**, the compensating ropes **35** are not caught in the corner. As a result, the rotation of the cylindrical rollers **20** does not become difficult and the compensating ropes **35** do not negatively influence the comfort of the ride in the car **1**.

Further, since the second guide **34** is composed of the second rotatable members **37** so that the compensating ropes

35 are directed in the direction in which they are moving, when a building sways due to a sudden gust of wind or an earthquake and the compensating ropes **35** contact the second rotatable members **37**, the second rotatable members **37** rotate so as to attenuate the friction between the second guide **34** and the compensating ropes **35** and to prevent the compensating ropes **35** from being damaged. Further, since the second rotatable members **37** are arranged to contact and guide the compensating ropes **35** when the compensating ropes **35** swing by a predetermined distance, the compensating ropes **35** do not contact the second rotatable members **37** in normal operation, except that the compensating ropes **35** swing a large distance due to a sudden gust of wind or an earthquake. Consequently, in normal operation, no unpleasant noise is caused by interference between the compensating ropes **35** and the second rotatable members **37**. Further, as shown in FIG. **5**, even if the compensating ropes **35** seem to get over the first guide **33** due to a big swing, the second guide **34** restricts that motion of the compensating ropes **35** and prevent the compensating ropes **35** from being pressed against the angle bracket **21** of the first guide **33** at acute angle and from being damaged.

FIG. **7** is a side view of a compensating rope guide of a third embodiment. In the following description, only components different from the components explained in the first embodiment are described.

In this embodiment, bars **23** are substituted for the rotatable members **15** in FIG. **2**. The bars **23** are respectively arranged at the wall **41** sides of the elevator shaft **4** on either side of the compensating ropes **35** and fixed to brackets **19***b* with U-shaped bolts **24** and nuts.

According to this embodiment, since the first guide **33** is composed of the bars **23** respectively arranged at the wall **41** sides of the elevator shaft **4** on either side of the compensating ropes **35** and the second guide **34** is composed of the bars **16**, the bars **23** restrict the swing of the compensating ropes **35** and the bars **16** prevent the compensating ropes **35** from getting over the bars **23** of the first guide **33**. As a result, the compensating ropes **35** do not swing by a large distance and have no influence on the comfort of the ride in the car **1**. Further, this embodiment reduces the cost of the compensating rope guide and provides an inexpensive elevator.

FIG. **8** is a side view of a compensating rope guide of a fifth embodiment of the present invention. In the following description, only components different from the components explained in the first embodiment are described.

The rotatable member **40** in the third embodiment shown in FIG. **6** is applied to the rotatable member **15** in FIG. **2**. In the fifth embodiment, the second guide **34** in FIG. **2** is omitted and two bell-shaped guides **25** are attached to both the upper and lower sides of the rotatable member **40** of the first guide **33** guiding linear portions of the compensating ropes **35**. The bell-shaped guides **25** are fixed to the rotatable member **40** with support member **26**.

According to this embodiment, the bell-shaped guides **25** keep the orbit of the compensating ropes **35** secure and prevent the compensating ropes **35** from being pushed against the angle bracket **21** at an acute angle, and from making unpleasant noise.

FIG. **9** is a side view of one of the rotatable members of the compensating rope guide of a sixth embodiment. In the following description, only components different from the components explained in the first embodiment are described. The rotatable member is applied to the rotatable member **15** in FIG. **2**. In this embodiment, rotatable member **42** is composed of four cylindrical rollers **20** supported by the angle bracket **21** like the rotatable member **15**. Each cylindrical roller **20** forms one side of a quadrilateral and the two facing pairs of cylindrical rollers **20** mutually intersect. One pair of cylindrical rollers **20** is placed above the other. Further, the edges of one pair of the cylindrical rollers **20** overlap inside a horizontally projected plane of the other pair of the cylindrical rollers **20**.

According to this embodiment, since the edges of one pair of the cylindrical rollers **20** overlap inside a horizontally projected plane of the other pair of the cylindrical rollers **20**, the compensating ropes **35** are not caught in a corner of the cylindrical rollers **20**. As a result, the rotation of the cylindrical rollers **20** does not become difficult and the compensating ropes **35** have no influence on the comfort of the ride in the car **1**.

FIG. **10** (*a*) is a plan view of a pair of rotatable members of a compensating rope guide of a seventh embodiment. FIG. **10**(*b*) is a side view of one of the rotatable members of the compensating rope guide of the seventh embodiment. In the following description, only components different from components explained in the first embodiment are described. The rotatable member is applied to the rotatable member **15** in FIG. **2**. In this embodiment, rotatable member **42** is composed of four cylindrical rollers **20** supported by the angle bracket **21** with a cut **43** corresponding to the path of the compensating ropes **35**. Each of the cylindrical rollers **20** forms one side of a quadrilateral and the two facing pairs of cylindrical rollers **20** mutually intersect. One pair of cylindrical rollers **20** is placed above the other. Further, the edges of one pair of the cylindrical rollers **20** overlap inside a horizontally projected plane of the other pair of the cylindrical rollers **20**.

According to this embodiment, since the cylindrical rollers **20** are supported by the angle bracket **21** with a cut **43** corresponding to the path of the compensating ropes **35**, if the compensating ropes **35** are pushed to the cylindrical rollers **20** due to a big swing, the compensating ropes **35** merely contact the angle bracket **21**. As a result, the compensating ropes **35** do not make unpleasant noise.

In the above embodiments, one second guide **34** is arranged in the pit **12**, but more than two second guides **34** placed one above the other may be arranged below the first guide **33**.

According to this invention, it is possible to provide a traction elevator having a compensating rope guide which can reduce the swing of a compensating rope so as to stop the emission of unpleasant noise and vibration of an elevator car, and thus not negatively influence the comfort of the ride in the car.

What is claimed is:

1. An elevator having a rope having a first end connected to a top of a car and a second end connected to a top of a counterweight, and the rope being guided and driven by a sheave that is rotated by a motor, comprising:

a compensating rope suspended from said car to said counterweight, said compensating rope having a curving portion, a first linear portion on a car side of said curving portion and a second linear portion on a counterweight side of said curving portion;

a first guide arranged to guide said first linear portion and said second linear portion;

a pair of second guides arranged below said first guide and positioned horizontally spaced apart between vertical lines extending from said first linear portion and said second linear portion for guiding said curving portion; and

a frame arranged in an elevator shaft for supporting said first guide and said second pair of guides;

wherein said pair of second guides is spaced apart by a distance equal to at least half of a distance between inner guiding surfaces of said first guides.

2. The elevator as recited in claim **1**, wherein:

said first guide comprises a rotatable member for directing said compensating rope in the direction in which it is moving.

3. The elevator as recited in claim **1** or claim **2**, wherein:

said second guide comprises at least one bar.

4. The elevator as recited in claim **1**, wherein:

said second guide contacts and guides said compensating rope at the time said compensating rope swings a predetermined distance.

5. The elevator as recited in claim **2**, wherein:

said rotatable member comprises cylindrical rollers.

6. The elevator as recited in claim **1** or claim **2**, wherein:

said pair of second guides comprises a second rotatable member for directing said compensating rope in the direction in which it is moving.

7. The elevator as recited in claim **1**, wherein:

said first guide comprises a plurality of bars arranged at a wall side of an elevator shaft away from said compensating rope.

8. The elevator as recited in claim **3**, wherein:

said cylindrical rollers include two pairs of cylindrical rollers that mutually intersect, said two pairs of cylindrical rollers being positioned one above the other.

9. The elevator as recited in claim **3**, wherein:

at least two of said cylindrical rollers are supported by an angle bracket with a cut corresponding to a path of said compensating rope.

10. The elevator as recited in claim **1**, further comprising:

a cylindrical cover rotatably covering a surface of said bar.

11. The elevator as recited in claim **6**, wherein:

the ends of one pair of rollers of said two pairs of rollers are arranged inside of a horizontally projected plane of the other pair of rollers.

* * * * *